Technical and Environmental Evaluation of Geothermal-Driven Hydrogen Production in Mexico

Alejandro Omana

ABSTRACT

Mexico has the potential to develop 9,686 MW of geothermal energy (GTE). As a renewable source, GTE could not only generate electricity but also heat and power for hydrogen electrolysis. Derisking GTE is a critical step for developing these energy systems. This study aims to model a GTE and hydrogen production (GTE+H2) operation in the geothermal greenfield of Santiago Papasquiaro, Durango, Mexico. Technical, economic, and environmental parameters are assessed by coupling a series of computational models. The geological uncertainty of the greenfield is evaluated with Monte Carlo simulation and statistical distributions. The field yields a theoretical expected value of 27 MW. Techno-economical modeling of a geothermal binary power plant reveals a 10.35 MW electricity capacity with two production and two injection wells for 30 years with a project net present value of $29.11 M and an internal rate of return of 10.28%. The modeled power plant leads to 480 tCO2 avoided. Four main parameters are identified for a competitive levelized cost of hydrogen (1.5–2$/kgH2) through a sensitivity analysis of the technology progress model of GTE+H2, which are (1) GTE CAPEX, (2) electrolyzer CAPEX, (3) electrolyzer efficiency, and (4) electrolyzer OPEX. Beyond assessing the cost competitiveness, the community benefits of GTE+H2 deployment could avoid up to 206 deaths caused by PM2.5 emissions. The results presented suggest that the deployment of GTE+H2 in the selected site in Mexico is techno-economically feasible and can strengthen the energy and fuel diversity of the country while improving air quality conditions for neighboring communities.

Sergio Castellanos

Dr. Sergio Castellanos, Supervisor

Dr. Carey King, Co-supervisor